MAGNETOELECTRONIC MICROARRAY DETECTION OF MAGNETICALLY LABELED BIOMOLECULES. Cy Tamanaha, Christina Cole, Shawn Mulvaney, Jack Rife and Lloyd Whitman, Naval Research Laboratory, Washington, DC 20375, email cy.tamanaha@nrl.navy.mil.

Abstract. Many of the current microarray technologies, particularly DNA arrays, rely on optical detection methods such as chemiluminescence, fluorescence, or colorimetric assays. We have developed a fundamentally different technique to quantitatively detect and identify biological molecules whereby captured molecules (e.g. DNA, proteins) are labeled with paramagnetic microbeads and subsequently detected by an array of giant magnetoresistance (GMR) magnetic field sensors embedded in the substrate (the Bead ARray Counter, or BARC chip).[1] A complete analytical system called the compact Bead Array Sensor System (*cBASS*), which integrates the electronic instrumentation with a compact fluidics system,[2] is being developed around this technology. Although our technology has its roots in biological warfare agent detection, it has many other potential applications, including biomedical research, point-of-care diagnosis, high-throughput drug screening, and environmental monitoring.

In its basic configuration, our biosensor system uniquely combines a receptor microarray, paramagnetic microbeads, GMR magnetic field sensors, and microfluidics to detect and identify biological molecules (see Figure 1). At its core is a BARC microchip containing the GMR sensor array. The assay is performed on the microchip in a flow cell using a hybrid macro-microfluidics system. Distinct receptor probes are immobilized above each sensor. Complementary target molecules (ligands) in a sample are captured by highly-specific ligand-receptor interaction on the chip, and are then labeled with paramagnetic microbeads. Controlled microfluidic forces are then applied to remove non-specifically bound microbead labels over the sensor area. Finally, the remaining magnetic labels are detected by the GMR sensors, providing a quantitative measure of the target concentration. The challenges of achieving effective assay and instrumental sensitivities in addition to the interdisciplinary effort required in making a complete, integrated sensor system based on this technology will be discussed.

[1]J. C. Rife et al., *Sens. Actuators A* **107** (2003) 209-218.
[2]C. R. Tamanaha et al., *J. Micromech. Microeng.* **12** (2002) N7-N17.

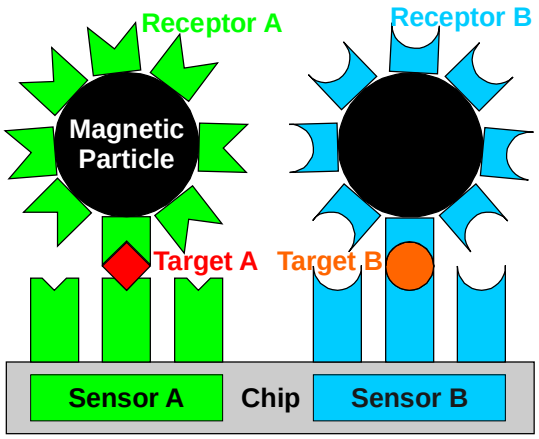

Figure 1. Generic illustration of magnetic labeling of target ligands captured onto a solid substrate in a sandwich configuration using specific biomolecular ligand-receptor recognition.